Multi-satellite mission KAGUYA (SELENE)

S. Sasaki (1), N. Namiki (2), H. Hanada (1), H. Araki (1), T. Imamura (3), T. Iwata (3) and RSAT/VRAD/RS Group
(1) National Astronomical Observatory of Japan, Oshu, Japan, (2) PERC, Chiba Institute of Technology, Japan,
(3) ISAS/JAXA, Sagamihara, Japan
(sho@miz.nao.ac.jp / Fax:+81-197-22-7120)

Abstract

KAGUYA (SELENE) is Japanese three-satellite mission for global remote sensing of the Moon. It was launched on September 14th, 2007 by JAXA and ended its operation on June 10th, 2009. KAGUYA has two small subsatellites, Rstar (OKINA) and Vstar (OUNA) for gravity measurement. The three satellites are tracked by new methods: 4-way Doppler tracking between the ground station and the main satellite by way of Rstar (Fig. 1) for the farside gravity and multi-frequency differential VLBI tracking between Rstar and Vstar. Using Rstar and Vstar, radio science (RS) experiment in KAGUYA (SELENE) mission was conducted to examine the lunar ionosphere using the method of radio occultation.

1. Introduction

The Japanese lunar explorer KAGUYA (SELENE) was launched successfully on September 14th, 2007 by JAXA and ended its operation on June 10th, 2009. KAGUYA takes polar orbits and observed the global Moon by June 10, 2009. KAGUYA observed the Moon by 14 instruments. Among them, there are two subsatellites Rstar (OKINA) and Vstar (OUNA). KAGUYA obtained first global topography and gravity of the Moon.

2. Gravity measurements

Synchronous rotation of the Moon with its orbit inhibits a direct link between a ground tracking station on the Earth and a lunar-orbiting spacecraft over the farside. Previously lunar farside gravity was obtained indirectly from direct tracking data mostly on the nearside. KAGUYA has two small spin-stabilized subsatellites, Rstar (OKINA) and Vstar (OUNA) for gravity measurement. Their weight is 50kg each. The main satellite of KAGUYA takes polar orbits with perilune 100km and apolune 800km. We tracked the three satellites by new methods: 4-way Doppler tracking between the ground station and the main satellite by way of Rstar (Fig. 1) for the farside gravity and multi-frequency differential VLBI tracking between Rstar and Vstar. Using Rstar and Vstar, radio science (RS) experiment in KAGUYA (SELENE) mission was conducted to examine the lunar ionosphere using the method of radio occultation.

3. Lunar ionosphere measurements

The radio science (RS) experiments in KAGUYA (SELENE) mission was conducted to examine the lunar ionosphere using the method of radio occultation. In the SELENE RS, using two radio frequencies of 2218 MHz and 8456.125 MHz transmitted from Vstar (OUNA), lunar ionosphere was observed. The two radio frequencies were used to extract the contribution from the electrons density along the ray path, especially from the terrestrial ionosphere. Additionally we use two subsatellites
Rstar (OKINA) and Vstar (OUNA) for the measurement. When Vstar is occulted by the lunar surface, radio signal from Rstar is used to measure the effect of terrestrial ionosphere. Difference between the signals from two satellites provides the lunar ionosphere component without being disturbed by the terrestrial ionosphere.

**References**

